CRASH RESEARCH & ANALYSIS, INC.
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ON-SITE AMBULANCE CRASH INVESTIGATION
SCI CASE NO.: CR12001

VEHICLE: 2007 FORD E450 CAB/CHASSIS
AMBULANCE BODY: HORTON TYPE III PATIENT COMPARTMENT

LOCATION: STATE OF NEW YORK

CRASH DATE: NOVEMBER 2012

Contract No. DTNH22-12-C-00269

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The crash investigation process is an inexact science which requires that physical evidence such as skid marks, vehicular damage measurements, and occupant contact points are coupled with the investigator's expert knowledge and experience of vehicle dynamics and occupant kinematics in order to determine the pre-crash, crash, and post-crash movements of involved vehicles and occupants.

Because each crash is a unique sequence of events, generalized conclusions cannot be made concerning the crashworthiness performance of the involved vehicle(s) or their safety systems.

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16. Abstract This on-site ambulance crash involved a van-based Ford E450 chassis with a Horton Type III ambulance body. The vehicle was transporting a 55-year-old male patient in a non-emergency mode when the restrained 45-year-old male driver suffered a heart attack causing him to lose control of the ambulance as it exited a left curve. The ambulance departed the right road edge, entered a ditch and struck several yielding objects including an earthen embankment. The restrained driver expired due to the heart attack. Two unrestrained Emergency Medical Technicians (EMTs) seated in the patient compartment sustained injuries and were transported to local hospitals where they were admitted for treatment of their injuries. The patient was transported, evaluated and released.			
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BACKGROUND

This on-site ambulance crash involved a van-based Ford E450 chassis with a Horton Type III ambulance body **(Figure 1)**. The vehicle was transporting a 55-year-old male patient in a non-emergency mode when the 45-year-old male driver suffered a heart attack causing him to lose control of the ambulance as it exited a left curve. The ambulance departed the right road edge, entered a ditch and struck several yielding objects including an earthen embankment. The restrained driver expired due to the heart attack. Two unrestrained Emergency Medical Technicians (EMTs) seated in the patient compartment sustained injuries and were transported to local hospitals where they were admitted for treatment of their injuries. The patient was transported, evaluated and released. The Crash Investigation Division (CID) of the National Highway Traffic Safety Administration (NHTSA) provided notification of the crash to the Crash Research & Analysis, Inc. (CRA) Special Crash Investigations (SCI) team on November 29, 2012. The SCI team immediately initiated telephone contact with the investigating police agency. Cooperation was obtained to inspect the vehicle which was in police custody. The on-site portion of this investigation was conducted on December 4-5, 2012 and involved the detailed inspection and documentation of the ambulance and the crash site, interviews with vehicle occupants, first responders, and Emergency Medical Services (EMS) personnel from the county and local jurisdictions.

Figure 1. Front left oblique view of the Ford E450 ambulance.

The Ford ambulance was occupied by the male driver, a 26-year-old EMT seated in the left, inward-facing Cardiopulmonary Resuscitation (CPR) seat of the patient compartment, a 52-year-old female EMT seated on the right, inward-facing bench seat, and the male patient restrained in a semi-Fowler position on the stretcher. The Ford departed the right road edge in a tracking mode and entered a drainage ditch that terminated at a T-intersection. As the Ford departed the road, the vehicle impacted a mailbox post prior to entering the ditch. While traversing the ditch, the frontal plane impacted a telephone splice box and a guy wire prior to the embankment

impact. The embankment impact displaced the frontal structure of the Ford minimally rearward, upward and laterally right. The supplemental air bag system of the Ford did not deploy. The Ford came to rest at the top of the embankment, partially blocking the intersecting street. Immediately following the crash, the patient unbuckled the manual restraints on the stretcher and exited the back of the ambulance to seek help. He proceeded across the street and summoned the assistance of the residents. The 26-year-old male EMT called for assistance using the ambulance radio; however, he could not offer the location of the crash. The 52-year-old female EMT remained in the ambulance and waited for medical assistance. The driver was pronounced deceased at the scene.

CRASH SUMMARY

Crash Site

Figure 2. Overall view of the crash site from the area of roadway departure.

The crash occurred off-road of a two-lane state highway near a T-intersection during nighttime hours in a rural, agricultural area. Local weather reports listed the ambient temperature at 3 degrees Celsius (26 degrees F), with 71 percent humidity, calm winds and overcast skies. The paved surfaces were dry. The east/west roadway consisted of two travel lanes that were divided by a solid double yellow centerline that prohibited passing in either direction. The asphalt surfaced travel lanes were 3.4 m (11.0 ft) in width and were bordered by a 1.8 m (6.0 ft) asphalt shoulder on the south side and a 1.5 m (5.0 ft) shoulder on the north side. A left curve having a radius of curvature of 352 m (1,157 ft) ended 82 m (270 ft) west of the struck embankment. The curve had negative grade of <2 % that transitioned to a sag followed by a positive grade of < 2% at the area of road departure. A drainage ditch was located south of the roadway with the ditch bank beginning 4 m (13 ft) south of the south road edge line. The ditch was 2.7 m (9.0 ft) in width with a depth of 1.2 m (4.0 ft). The ditch was dry and was comprised of soft soil in the ditch bottom. The ambulance struck three yielding objects; a mailbox post, a telephone splice box, and guy wire cable. The mailbox was located at roadside while the utility box and the guy wire anchor were located within the ditch bottom. The ditch transitioned into a concrete culvert and an earthen embankment at the T-intersection. The embankment bordered the intersecting street and was oriented perpendicular to the Fords path of travel. The slope of the embankment was positive 52 degrees. The posted speed limit on the state route was 72 km/h (45 mph). The roadway and intersection areas were not lighted. **Figure 2** is an overall view of the crash site from the area of roadway departure.

Pre-Crash

The ambulance and its volunteer crew of EMTs responded to a call in an adjacent district to cover a call to transport a patient complaining of chest pains. The patient was at his residence and following the arrival of the ambulance, he was placed on the Stryker ambulance stretcher and restrained by three lateral restraints positioned across his chest, pelvic region, and lower extremities. He was reclined to a semi-Fowler[1] position and loaded into the ambulance. Two leads for the heart monitor were placed on his chest and a blood pressure cuff was placed on his right arm. The ambulance departed his residence and travelled in a non-emergency mode for a distance of 8 km (5 mi) to the crash site. During this travel, the driver was traveling in an easterly direction and negotiated a series of curves with changing elevations. On approach to the crash site, the driver successfully negotiated the left curve. The curve terminated to a straight segment of road at a point 95 m (312 ft) west of the embankment impact.

As he exited the curve, the driver experienced a heart attack and lost control of the ambulance. The ambulance drifted right and departed the right road edge in a tracking mode at a point that was approximately 61 m (200 ft) west of the referenced embankment. The right side dual rear tires marked on the grass roadside 43 m (140 ft) west of the embankment as the ambulance traversed a paved driveway apron and entered the drainage ditch.

Crash

The front left aspect of the ambulance impacted and fractured the mailbox post that was located 2.7 m (8.7 ft) south of the south road edge. The post was snagged by the frontal plane and dragged along its trajectory, evidenced by a gouge mark located between the rotating tire marks. This 12 o'clock direction of force impact did not alter the trajectory of the ambulance or reduce its speed as it entered the ditch.

Figure 3. Ditch bottom and the objects struck.

The ambulance traversed the ditch bank and tracked along the bottom of the ditch as the right side tires furrowed into the ditch bottom. The furrowing into the ditch bottom produced a level of deceleration to the vehicle as it continued on an easterly trajectory. The front right aspect of the ambulance impacted and fractured a telephone splice box that located in the ditch bottom 20.2 m (66.5 ft) east of the struck mailbox location. Again, this 12 o'clock impact force did not alter or slow the ambulance. **Figure 3** is a view of the ditch and the objects struck.

The front right corner of the right front fender impacted and fractured a guy wire cable that was affixed to a ground anchor located 5.3 m (17.5 ft) east of the utility box. This 12 o'clock

1 – Semi Fowler is a standard patient position with a 30-45 degree raised position of the head/chest to allow for improved breathing in immobile patients.

direction of force impact produced minor sheet metal damage to the fender edge of the ambulance.

The ambulance continued forward and engaged the earthen embankment located at the east end of the ditch. The 1.2 m (4.0 ft) high embankment was comprised of soft dirt **(Figure 4)** that was displaced by the frontal and undercarriage planes of the ambulance. The embankment minimally displaced the frontal structure rearward, upward, and laterally right resulting in a force direction that was non-horizontal (00 o'clock). The right front tire and wheel separated from the axle spindle during the embankment engagement. The frontal air bags did not deploy during the long duration crash event and the safety belt buckle pretensioners did not actuate.

Figure 4. Struck embankment.

The ambulance rode up the embankment and came to rest on the intersecting street with the rear axle of the ambulance positioned near the top of the embankment. At rest, the unit was facing in an easterly direction. A **Crash Diagram and an Expanded Crash Diagram**, depicting the left curvature of the road, are included at the end of this technical report.

Post-Crash

Immediately following the crash, the patient unbuckled his lateral restraints and stood up from the stretcher and opened the rear doors in an attempt to seek assistance. He jumped down from the back plane of the ambulance onto the struck embankment and proceeded across the two lane state route to a neighboring farm house. It should be noted that he was without clothing on his upper body and without shoes or socks. He gained the attention of the resident and asked that he call 911 to report the crash. The patient remained in the residence until another ambulance arrived to complete his transport.

The first responding firefighter to arrive on-scene resided on the intersecting road, west of the crash site. He was off-duty and drove to the site in his personal vehicle with his wife. He observed the ambulance without lights, blocking the intersection.

The 26-year-old male EMT was displaced forward as a result of the crash. He came to rest in the pass-through of the ambulance between the patient compartment and the cab, against the engine cover between the front seats and had sustained a large scalp laceration. The laceration resulted in significant blood loss. He attempted to call for help using the cab-mounted radio; however, this unit was inoperative. The EMT proceeded to the patient compartment and used the

microphone that was mounted above the left counter space. His call to the emergency response system reported the need for assistance, but the nature of the call and the location were not provided. The male EMT exited the ambulance and was found walking around the crash site by the first responding firefighter. The EMT was without shoes and complained that his feet were cold. The firefighter instructed him to sit in his personal vehicle; however, the EMT declined due to bleeding of his scalp laceration. He sat on the vehicle's back tailgate and waited for emergency help to arrive.

The 52-year-old female EMT came to rest on the floor of the ambulance in the pass-through between the cab and the patient compartment. She was evaluated by the first responders in this location and was placed on a backboard for removal from the ambulance.

The driver of the ambulance was found slumped in his driving position, restrained by the manual safety belt system. The first arriving EMS personnel evaluated his condition and determined that he was deceased. His body was subsequently removed from the cab of the ambulance and he was pronounced deceased by the County Coroner. The patient and both EMTs were transported by ambulance to a local hospital where they were evaluated for their injuries. The patient was treated for soft tissues and released following a full evaluation for his chest pains. He was not injured. The 52-year-old female EMT was admitted for treatment of multiple fractured ribs and a liver laceration. She was released three days post-crash. The male EMT was determined to have sustained a brain injury and was prepared for transfer to a regional trauma center in an adjacent state. He underwent a procedure to relieve intracranial pressure associated with a subarachnoid hemorrhage. The male EMT was released two days post-crash.

2007 FORD E450 AMBULANCE

Chassis

The chassis of the ambulance was a medium-duty Ford E450 with a Gross Vehicle Weight Rating (GVWR) of 6,373 kg (14,050 lb). The Gross Axle Weight Ratings were 2,087 kg (4,600 lb) front and 4,287 kg (9,450 lb) rear. The 4x2 driveline configuration had a 401 cm (158 in) wheelbase. The Ford was manufactured as an incomplete vehicle with the ambulance prep package in March 2007 and was identified by Vehicle Identification Number (VIN): 1FDXE45P27Dxxxxxx. The Ford was powered by a 6.8 liter, V-10 turbo diesel engine linked to a 4-speed automatic transmission. The service brakes were power-assisted hydraulic four wheel disc with ABS. The Ford was equipped with OEM steel wheels with full coverage deep-dish polished stainless hub caps. The vehicle manufacturer recommended tire size was LT225/75R16E front and rear with cold tire pressures of 450 kPa (65 PSI) front and 550 kPa (80 PSI) rear. At the time of the crash, the ambulance was equipped with Michelin LTX tires of the recommended size on the front axle and the right rear dual positions. The left rear tires were Goodyear Wranglers of the recommended size. The specific tire data at the time of the SCI investigation are detailed in the following table:

Position	Measured Tire Pressure	Measured Tread Depth	Restricted	Damage
LF	Flat	10 mm (12/32 in)	No	None, tire debeaded
LR Outer	Unknown	7 mm (9/32 in)	No	None
LR Inner	Unknown	8 mm (10/32 in)	No	None
RR Inner	300 kPa (43.5 PSI)	6 mm (8/32 in)	No	None
RR Outer	176 kPa (25.5 PSI)	6 mm (8/32 in)	No	None
RF	255 kPa (37.0 PSI)	10 mm (12/32 in)	N/A, separated	None, separated from axle

Patient Compartment

The Type III patient compartment was manufactured by Horton Emergency Vehicles of Grove City, Ohio in August 2007. The Model Number was 553 with a Production Number of 12917 and a Serial Number of J130712917. The unit was constructed of formed aluminum corner posts, side rails and headers with 5x5 cm (2x2 in) aluminum tubing forming the lateral structure of the roof and floor and the vertical structure of the walls. The exterior surfaces were aluminum panels of 3 mm (0.125) in thickness. The interior walls were high density aluminum composite. The exterior dimensions of the patient compartment were 429 cm (169 in) in length, 224 cm (88 in) in height and 244 cm (96 in) in overall width. The interior ceiling height was 183 cm (72 in). The width of the floor was 126 cm (49.5 in). **Figure 5** is an overall view of the patient compartment.

Figure 5. Right oblique view of the Horton patient compartment.

The patient compartment was equipped with an 81x211 cm (32x83 in) right side door and two rear doors for patient loading. These center closing doors were 62x157 cm (24.5x62 in) in overall dimensions. The doors and all exterior storage compartments consisted of full length stainless hinges and flush mounted latches. The interior surfaces of the exterior storage compartments were lined with aluminum diamond plate. Window glazing consisted of a 44x44 cm (17.5x17.5) slider in the right side door, a fixed 89 x38 cm (35x15 in) window over the right rear axle location (interior bench seat) and 46x46 cm (18x18 in) fixed windows in each of the two rear doors. All glazing was AS3 tempered glass.

Exterior visual warning lighting consisted of surface mounted lights to the front bulkhead, both sides and the rear of the patient compartment. There no lights mounted to the roof of the cab or the patient compartment.

The interior of the patient compartment was configured rear-facing high back Captain's chair with a lap belt restraint system, a left, inward facing CPR seat with a lap belt system affixed to the side wall, and a right, inward facing 3-person bench seat with dual purpose lap belts to restrain seated occupants or a patient on a backboard.

The stretcher was center-positioned within the floor of the patient compartment and secured by the forward-mounted antler bracket and a left side-mounted Stryker rail clamp that was identified by Serial No. 070741451.

Exterior Damage - Ford E450 Cab/Chassis

The Ford was involved in four impact events during this crash sequence **(Figure 6)**. The initial impact involved the mailbox post at the west roadside. The post was fractured by the center right aspect of the front bumper; however, there was no direct contact evidence on the bumper associated with this event. The Collision Deformation Classification (CDC) was 12FZEU1.

Figure 6. Frontal damage to the cab of the Ford E450.

The Ford entered the ditch and struck a square telephone splice box that was located at the bottom aspect of the ditch. This impact fractured the utility box, however, did not produce residual damage to the Ford. The CDC for this event was 12FZEU1.

The leading edge of the right front fender impacted a cable guy wire for a utility pole. The guy wire was oriented parallel to the roadway. The impact separated the guy wire from either the ground mounting rod or the upper aspect of the utility pole. (The cable was removed from the scene prior to the SCI investigation.) The resulting damage to the Ford was located at the right edge of the fiberglass hood and the fender edge, beginning 89 cm (33.5 in) right of center and extending 8 cm (3 in) to the right corner. Centered within the area of direct contact and deformation was a lateral abrasion pattern associated with the cable. The depth of crush at this location was 3 cm (1 in). The CDC for this impact was 12FRMN1.

The fourth impact event was the most severe and was related to the earthen embankment. Post-crash, the slope of the embankment, although altered by the crash, was approximately 52 degrees. The front bumper and undercarriage engaged the embankment as the vehicle was deflected upward and climbed the embankment. The direct contact damage on the bumper was 172 cm (67.75 in), extending from corner-to-corner. The damage profile along the face of the

bumper was as follows: C1 = 4 cm (1.75), C2 = 2 cm (0.75”), C3 = 1 cm (0.25”), C4 = 0 cm, C5 = 0 cm, C6 = 0 cm. Maximum crush was located at the front left corner of the bumper.

The non-horizontal component of the impact force that involved the lower bumper and undercarriage deflected the frontal structure upward. A lateral shift also occurred to the front frame rails, displacing the structure to the right. The lateral displacement resulted in separation of the laminated windshield from both A-pillars, along the base of the glazing, and 38 cm (15 in) along the header, originating at the centerline, extending left.

The left wheelbase was reduced in length by 3 cm (1 in). The right front tire furrowed into the ditch bottom and heavily engaged the base of the embankment as the front wheels were turned in a clockwise direction. This resulted in a lateral loading to the inside surface of the tire and wheel. The threads of the castle nut at the outer end of the spindle striped, separating the nut from the spindle. Consequently, the outer wheel bearing slid off the spindle, the brake rotor fractured, and the tire/wheel/hub separated from the vehicle. During the separation, the tire/wheel engaged the aft edge of the wheel opening, displacing the fender and aluminum running board rearward. The right wheelbase was reduced by 10 cm (4 in).

Superficial abrasions and mud were transferred onto both lower side surfaces as the Ford climbed the embankment. The CDC for the embankment impact was 00FDLW1.

An analysis of the crash severity (delta-V) of these impacts was beyond the scope of the WinSMASH model. The estimated cumulative severity of damage to the Ford was moderate.

Event Data Recorder

The 2007 Ford E450 diesel was not equipped with an EDR supported by the Bosch Crash Data Retrieval (CDR) tool.

Patient Compartment - Exterior

The Type III patient compartment remained intact on the chassis and did not display visible evidence of damage. Outside of the previously mentioned sideswipe transfers to the lower side aspects of the body, there was neither structural nor superficial damage to the patient compartment. All exterior doors remained closed and maintained proper gap clearances post-crash. All doors and compartments remained fully operational. The glazing in the right side and rear doors was not damaged. The large right side glazing over the right side bench seat was not damaged. The roof of the patient compartment was intact with no evidence of buckling or deflection.

Interior Damage - Ford Cab

The interior damage to the occupant compartment of the Ford E450 chassis was limited to several intrusions, driver contact and blood transfers from the EMT that was initially seated in the patient compartment. The intrusions consisted of 6 cm (2.5 in) of rearward displacement of the left A-pillar (measured at the level of the striker plate) and left mid instrument panel. The right A-pillar was displaced 4 cm (1.5 in) rearward and resulted in a matching displacement of the right mid instrument panel. The left floor pan buckled downward at the left side of the engine cover, exposing the transmission casing. The engine cover was partially separated from its attachment points and engaged the left leading aspect of the front right passenger seat. Figure 7 is an overall view of the driver compartment and cab of the Ford E450.

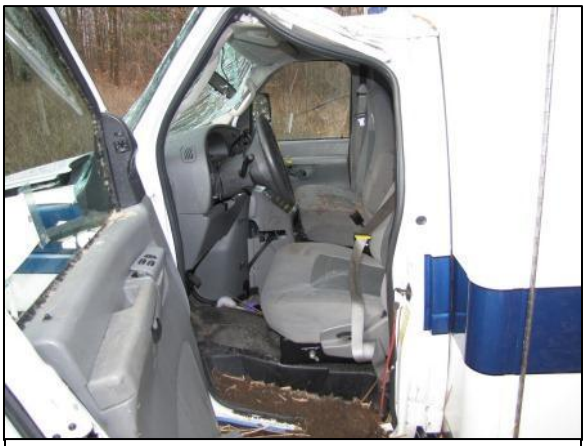


Figure 7. Overall view of the driver compartment and cab of the Ford E450.

Both front door latches released from stress overload during the engagement with the embankment as the A-pillars displaced rearward.

The driver, although belted, loaded the right upper quadrant of the steering wheel rim. This subtle loading did not deform the wheel rim or spokes, but deformed the mounting flange. The gap between the steering wheel hub and the column was minimally closed at the upper right quadrant area.

The knee bolster panel partially separated at the right attachment point due to A-pillar/instrument panel displacement. There was no loading evidence associated with driver contact.

The engine cover, center floor, right front seat cushion and the center mid instrument panel were stained with blood from the 26-year-old EMT as he attempted to use the front-mounted radio and call for assistance. There was no distinct contact points within the cab of the vehicle associated with this occupant.

Interior Damage - Patient Compartment

The interior of the patient compartment was not damaged during the crash. Several members of the EMS removed all equipment from the ambulance prior to the SCI inspection. The interior was configured with rollup doors for the compartments located at the forward right and aft left corners of the patient compartment. All other compartments were closed by Plexiglas doors with latches and top mounted hinges. The compartment at the left front corner area was equipped

with sliding doors. All doors were intact and free of damage. The EMTs indicated the rollup door at the front right corner was open as this contains the drug bag. The soft sided drug bag was opened and positioned on the right side bench seat.

The Lifepac 12 cardiac monitor was stalk-mounted to the counter at the left of the patient compartment, forward of the CPR seat. The monitor remained in place post-crash and was returned to the distributor for testing prior to being put back into service.

There were occupant contact points within the patient compartment. Blood evidence was present of the sides of the pass through to the cab of the ambulance and around the left microphone area as the male EMT called to request assistance. The stretcher was removed from the ambulance and was stored at a separate location. **Figure 8** is a view of the ambulance as found at the time of the SCI inspection. **Figure 9** is a view of an exemplar ambulance with all equipment in place and displayed.

Figure 8. Forward view of the patient compartment and blood evidence within.

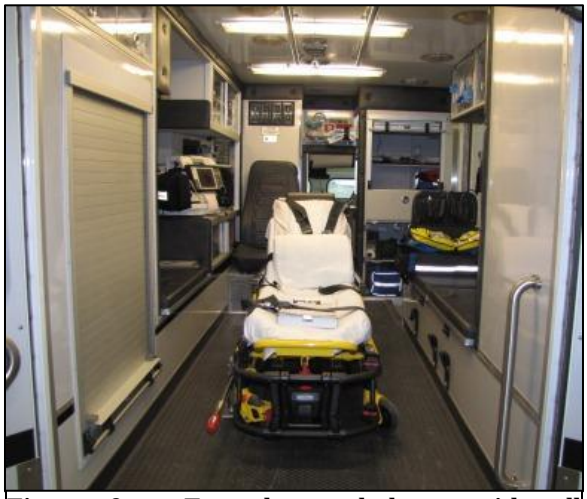


Figure 9. Exemplar ambulance with all equipment displayed.

Manual Safety Belt Systems

The Ford E450 chassis was equipped with manual 3-point lap and shoulder safety belts for the driver and front right passenger positions. The belt systems consisted of continuous loop webbing that spooled onto Emergency Locking Retractors (ELR), sliding latch plates, adjustable D-rings, and buckle pretensioners that were mounted to the box-mounted seat frames. The front right position was not occupied.

The driver utilized the safety belt system during the crash. Belt usage was determined from loading evidence on the latch plate and belt webbing, and from the observations of the first responders. Frictional abrasions were present of the full-width of the latch plate cross bar. A

subtle diagonally oriented D-ring transfer was present on the belt webbing, near the end of the webbing when fully extended from the retractor. This was consistent with the demographics of the driver.

The patient compartment was equipped with locking retractor lap belt for the designated seating positions. None of the lap belt restraints were used by the EMTs.

Supplemental Restraint Systems

The Ford was equipped with frontal air bags for the driver and front right passenger positions. The driver bag was conventionally mounted within the hub of the steering wheel while the front right air bag was a mid-mount configuration. The air bags did not deploy during the multiple event, long duration crash.

The safety belt systems in the cab of the Ford chassis were equipped with buckle pretensioners. The pretensioners did not actuate during the crash.

Ambulance Stretcher

The ambulance stretcher was removed from the ambulance at the crash site and was transported back to the ambulance facility where it was inspected for this investigation. The on-duty EMTs at the time of the SCI inspection placed the back rest in the presumed semi-Fowler position, a position they use when transporting patients with chest pains.

The stretcher was a Stryker Power Pro XT with a 318 kg (700 lb) patient capacity. It was configured with a battery operated power-lift system. The Serial Number was 091240907. The restraints consisted of three lateral belts that were tied to the tubing at the chest, pelvic and lower extremity regions of an adult patient. Two shoulder restraints were tied to the top crossbar of the stretcher. The patient was restrained in a semi-Fowler position by the three lateral restraints; however, the shoulder restraints were not used. A vinyl cover foam cushion with a thickness of (3 in) covered the patient surface of the stretcher and was held in place by Velcro. The stretcher was secured to the floor of the ambulance by the front mounted antler bracket and the left side rail clamp.

During the crash sequence and primarily at impact with the embankment, the patient loaded the backrest of the stretcher. Although the restraints held the patient in position on the stretcher, his loading force was translated into the frame of the stretcher. A cross tube that was located in the area of his pelvic region was stressed vertically. The polymer rackets that secured this tube fracture on the bottom aspects allowing the tube to separate from its pivot points. The perforated aluminum tray located directly rearward of this cross tube deflected upward, deforming the tray at the area of the patients upper thighs. The forward pivot arm for the side rail at the patient's left side was minimally deformed. This possibly resulted from the patient or EMT loading

during the crash or from the post-crash removal of the stretcher from the patient compartment. Although the stretcher did sustained damage, its overall integrity was maintained and it remained in its locked position. **Figure 10** is an overall view of the stretcher and **Figure 11** is a close-up of the loading damage to the mid frame area.

Figure 10. Overall view of the stretcher with the backrest positioned semi-Fowler.

Figure 11. Separation of the stretcher cross member and deflection of the lower extremity pan.

2007 FORD AMBULANCE OCCUPANTS

Driver Demographics

Age/Sex:	45 years/Male
Height:	183 cm (72 in)
Weight:	204 kg (450 lb)
Eyewear	None
Seat Type:	Box-mounted seat with an integral head restraint
Seat Track Position:	Full-rear
Manual Restraint Usage:	3-point lap and shoulder belt system
Usage Source:	Vehicle inspection, observations of the first responders
Air Bags:	No deployment
Alcohol/Drug Involvement:	None reported
Egress from Vehicle:	Deceased, removed by the emergency responders
Transport from Scene:	Coroner to the County Morgue
Type of Medical Treatment:	None, autopsy

Driver Injuries

Injury No.	Injury	AIS 2005/08	Injury Source	Confidence
1	Laceration over right eye	210602.1,7	Steering wheel rim	Certain

Source: Interview of the First Responders

Driver Kinematics

The driver of the ambulance was seated in a box-mounted seat in an unknown posture with the seat adjusted to a full-rear track position. The seat back was slightly reclined against the back wall of the cab. He was restrained by the manual safety belt system. Belt usage was determined from frictional abrasions on the crossbar of the sliding latch plate and from a subtle D-ring transfer of the shoulder belt webbing.

Prior to the crash sequence, the driver experienced a heart attack that caused him to lose control of the ambulance. As a result, the ambulance drifted to the right and departed the right road edge to impact with the yielding objects. During the crash events, the driver initiated a forward trajectory and loaded the manual safety belt system as the inertia-activated retractor locked the webbing. His head, and possibly his torso, impacted the steering wheel rim. Although there was no deflection of the rim, the steering wheel flange was deformed at the upper right quadrant. It was reported by the first responders, that the driver sustained a small laceration over his right eye. The driver rebounded into the driver's seat where he came to rest slumped slightly to the right.

The volunteer first responders to the crash site evaluated the driver. He was found without respiration and pulse and was declared to be deceased. His body was removed from the cab of the E450 and transported to the County Medical Examiner's office for autopsy. It was determined that the driver suffered a heart attack which then initiated the crash sequence.

EMT 1 Demographics

Age/Sex:	26 years/Male
Height:	183 cm (72 in)
Weight:	102 kg (225 lb)
Eyewear	None
Seat Type:	Left side CPR seat of the patient compartment
Seat Track Position:	Fixed
Manual Restraint Usage:	None
Usage Source:	Vehicle inspection
Air Bags:	Not equipped
Alcohol/Drug Involvement:	None reported
Egress from Vehicle:	Exited unassisted
Transport from Scene:	Transported by ground ambulance to a local hospital and then transferred to a regional trauma center
Type of Medical Treatment:	Admitted for two days

EMT 1 Injuries

Injury No.	Injury	AIS 2005/08	Injury Source	Confidence
1	Major scalp laceration (20 cm total length) above the right eyebrow along the scalp line to the crown extending down into the galea	110604.2,5	Vertical edge of patient compartment pass-through	Possible
2	Right diffuse subarachnoid hemorrhage, temporal tip through the Sylvain fissure tracking superiorly to the right convexity	140694.2,1	Vertical edge of patient compartment pass-through	Possible
3	Avulsion laceration of the bridge of the nose	210800.1,4	Engine cover	Possible
4	Left hand abrasion	710202.1,2	Unknown	Unknown
5	Multiple right leg abrasions (thigh and lower leg)	810202.1,1	Stretcher	Probable

Source – Emergency Room records, Radiology, Discharge Summary, Procedure Notes

EMT 1 Kinematics

The 26-year-old male EMT was seated on the left CPR seat in a side-facing position toward the patient. He was not restrained by the available lap belt. In response to the frontal crash forces, he moved laterally to his left and forward with respect to the patient compartment. His lateral movement separated the leads from the patient to the cardiac monitor and the blood pressure cuff that was also connected to the monitor. His lower extremities engaged the frame of the stretcher which separated his shoes from his feet and produced multiple right leg abrasions. The EMT's engagement with the stretcher slowed his forward trajectory. The right side seated EMT moved forward ahead of this occupant.

Located within his range of motion to his left was a portable Oxygen bottle that was positioned at the head of the stretcher and the LifePac 12 cardiac monitor. These were not reported as damaged or displaced by the crash or as a result of occupant contact. Both items were removed from the ambulance prior to the SCI inspection.

The EMT continued on his trajectory to the forward aspect of the patient compartment. There was no distinct contact evidence to support a head impact within patient compartment of the cab of the Ford E450. Blood transfers were present on the sidewalls to the pass-through, on the engine cover, floor and right front seat cushion. It is theorized that he impacted his head on a hard surface or hard edge causing the 20 cm (8 in) laceration across his forehead and scalp with an underlying right subarachnoid hemorrhage. The most likely injury source was the stainless steel vertical edge of the pass through to the cab of the ambulance.

The male EMT continued forward, leading with his head and entered the cab of the Ford chassis. His face struck the engine cover resulting in a laceration across the bridge of the nose. The EMT came to rest lying on the floor of the pass through, adjacent to, or partially on top of the female EMT. He remained conscious during the crash and called on the radio to request assistance. He could not provide the nature of the call or the crash location. He exited the ambulance through the back doors and was found walking around the crash site by the first responder. The EMT was subsequently treated at the scene and transported by ground ambulance to a local hospital where he was treated and prepared for transfer to the regional trauma center. He was released two days after the crash.

EMT 2 Demographics

Age/Sex:	52 years/Female
Height:	173 cm (68 in)
Weight:	93 kg (205 lb)
Eyewear	None
Seat Type:	Right bench seat
Seat Track Position:	Fixed
Manual Restraint Usage:	None used
Usage Source:	Vehicle inspection
Air Bags:	Not equipped
Alcohol/Drug Involvement:	None reported
Egress from Vehicle:	Removed by the emergency responders
Transport from Scene:	Ground ambulance to a local hospital
Type of Medical Treatment:	Admitted for three days

EMT 2 Injuries

Injury No.	Injury	AIS 2005-08	Injury Source	Confidence
1	Acute fractures of right ribs 4 through 7, non-dsplaced fractures of right ribs 3, 8, 9	450203.3,1	Vertical edge of patient compartment pass-through	Possible
2	Loss of consciousness	161002.2,0	Vertical edge of patient compartment pass-through	Possible
3	Small contusion right lung lower lobe	441407.2,1	Vertical edge of patient compartment pass-through	Possible
4	Small right pneumothorax	442202.2,1	Vertical edge of patient compartment pass-through	Possible

Injury No.	Injury	AIS 2005-08	Injury Source	Confidence
5	Small liver laceration involving the caudate lobe with small associated hemorrhage	541820.2,1	Vertical edge of patient compartment pass-through	Possible
6	Left frontal (temple) scalp hematoma	110402.1,2	Unknown	Unknown
7	Right occipital scalp hematoma	110402.1,6	Unknown	Unknown
8	Large contusion around the left eye	210402.1,7	Unknown	Unknown
9	5 cm laceration of the forehead	210602.1,7	Unknown	Unknown
10	Contusion on the right abdomen/flank	510402.1,1	Vertical edge of patient compartment pass-through	Possible
11	Multiple bilateral lower extremity contusions	810402.1,3	Stretcher	Probable

Source – Emergency Room Records, Discharge Summary, Radiology

EMT 2 Kinematics

The 52-year-old female EMT was seated on the forward aspect of the right side bench seat of the patient compartment in a side-facing position. She was not restrained by the manual lap belt system. The EMT was possibly displaced forward with respect to the patient compartment by the impact with the guy wire and the furrowing into the ditch bottom that produced a level of deceleration to the vehicle.

At impact with the embankment, she moved laterally to her right and forward with respect to the patient compartment. The crash bar/handrail at the forward edge of the bench seat was not deformed. Her left arm possibly struck the head of the patient resulting in a laceration to the patient. The EMT's head and right chest/flank probably impacted the ridged stainless steel vertical edge of the pass-through to the cab of the ambulance. This suspected contact resulted in acute fractures of the right ribs 4-7, non-displaced fractures of right ribs 3, 8 and 9, a small right lower lobe lung contusion, small right pneumothorax, a contusion of the right flank, and a liver laceration. She also sustained a loss of consciousness.

The EMT sustained a laceration of the forehead, a contusion of the left eye, and a right occipital scalp contusion from unknown sources. The first responders found the EMT on the floor in the pass-through area. There was no distinct contact evidence to support the specific source of her injuries. The female EMT was placed on a backboard and was removed from the ambulance where she was transferred to a stretcher and transported to a local hospital where she was admitted for treatment of her injuries.

Patient Demographics

Age/Sex:	55 years/Male
Height:	173 cm (68 in)
Weight:	94 kg (208 lb)
Eyewear	None
Seat Type:	Lying in a semi-Fowler position of the ambulance stretcher
Seat Track Position:	Fixed
Manual Restraint Usage:	Three lateral belts across the chest, pelvis, and lower extremities
Usage Source:	EMT statements
Air Bags:	Not equipped
Alcohol/Drug Involvement:	None reported
Egress from Vehicle:	Exited unassisted
Transport from Scene:	Ground ambulance to a local hospital
Type of Medical Treatment:	Treated and released

Patient Injuries

Injury No.	Injury	AIS 2005/08	Injury Source	Confidence
1	Left scalp laceration	110600.1,2	Occupant-to-Occupant interaction with the female EMT	Possible
2	Left knee contusion	810402.1,2	Unknown	Unknown
3	Right hip contusion	810402.1,1	Unknown	Unknown

Source – Emergency Room Records

Patient Kinematics

The 55-year-old male patient was lying in a semi-Fowler position on the stretcher that was secured to the ambulance by the antler bracket and left side-mounted rail clamp. The patient was restrained on the stretcher by three lateral restraints positioned at the level of the chest, pelvis and the lower extremities. During his transport, the patient had an IV in his left arm, a blood pressure cuff on his right upper arm, and leads from chest sensors to the cardiac monitor.

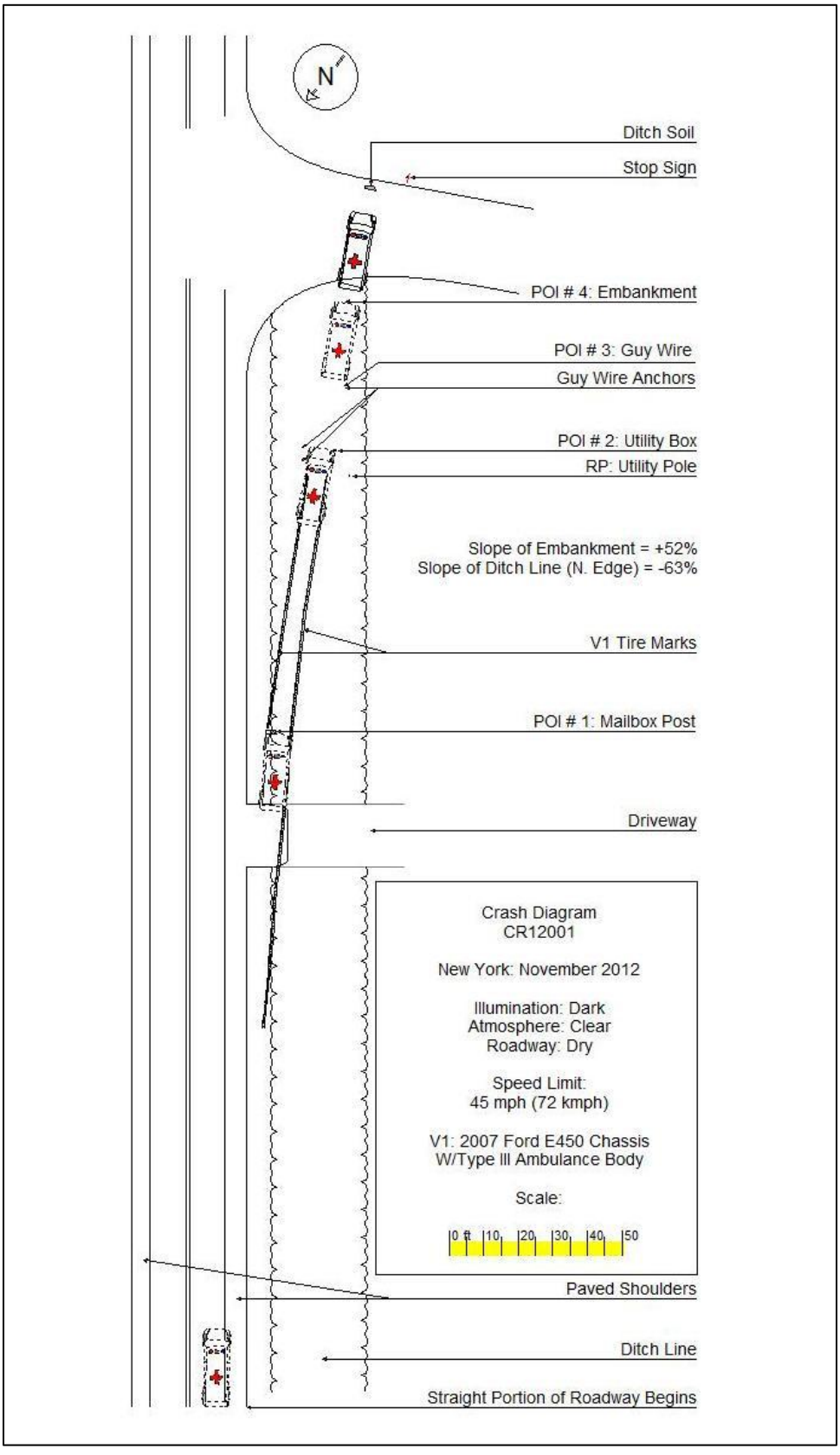
The patient responded to the crash forces by initiating a forward trajectory with respect to the patient compartment. He loaded the backrest of the stretcher that was linked to the panel under his pelvis. The loading force fractured the polymer cups that secured a cross bar to the longitudinal frame of the stretcher. As a result, the cross bar separated from the brackets. The panel under the patient's legs bowed during the dynamic deflection of the stretcher. Although damaged, the stretcher remained secured to the containment system and remained in place in the patient compartment.

As the male EMT moved forward at the patient's right side, he engaged the leads to the cardiac monitor and separated the leads from the patient. This did not produce injury to either occupant.

The left arm of the EMT seated on the right bench seat, or an internal loose object possibly struck the patient in the head resulting in a left scalp laceration. The patient also sustained contusions of the left knee and right hip from unknown sources.

Following the crash, the patient pulled the IV line from the drip bottle, unbuckled the lateral restraints, and exited the patient compartment through the back doors. He proceeded across the roadway to a neighboring farm house where he summoned help and waited for emergency personnel. The patient was transported by ground ambulance to a local hospital where he was evaluated for chest pains, treated for his injuries and released.

CRASH DIAGRAM



EXPANDED CRASH DIAGRAM